

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A packet communication method using a plurality of packet transfer apparatuses which are connected to a network and transfer a lower layer frame containing an encapsulated upper layer packet, at least one frame transfer apparatus which mediates transfer of the lower layer frame between the plurality of packet transfer apparatuses through the network, and a network control server which is connected to each of the plurality of packet transfer apparatuses and said at least one frame transfer apparatus and controls a communication route of the lower layer frame in the network by giving an instruction to the plurality of packet transfer apparatuses and said at least one frame transfer apparatus, wherein

- each of the plurality of packet transfer apparatuses comprises
 - an extraction procedure which extracts, from a received lower layer frame, a lower layer address pair including a transmission source address and a destination address of a lower layer,
 - a first registration procedure which registers a sending destination of the received lower layer frame in a first table for each corresponding destination address,
 - a first counter procedure which counts, for each type of lower layer address pair, a quantity of the lower layer address pairs extracted by the extraction procedure, and
 - a first transmission procedure which transmits, to said at least one frame transfer apparatus, first information representing each lower layer address pair counted by the first counter procedure beyond a predetermined threshold value within a predetermined time,
- the at least one frame transfer apparatus comprises
 - a second registration procedure which registers ~~a transfer~~ the sending destination of the received lower layer frame in a second table for each destination address contained in the lower layer frame,
 - a second counter procedure which counts a quantity of transferred lower layer frames for each type of lower layer address pair contained in the first information received from the packet transfer apparatus, and
 - a second transmission procedure which transmits, to the network control server, second information about each lower layer address pair counted by the second counter procedure beyond a predetermined threshold value within a predetermined time, and
- the network control server comprises

a calculation procedure which, upon receiving the second information, extracts the transmission source address and the destination address from the second information and executes calculation to optimize the communication route in the network between the transmission source address and the destination address, and

a change procedure which changes registration of the sending destination of the received lower layer frame, registered in the first table and the second table, on the basis of the calculation result.

2. (Cancelled)

3. (Currently Amended) A packet communication method according to claim 1, wherein, when transmitting the first information to the frame transfer apparatus, said first transmission procedure transmits information about the destination address, ~~contained in the frame information of the received lower layer frame, and about a destination address of an upper layer corresponding to the destination address, from the frame information,~~ to a transmission source address of each lower layer address pair contained in the first information, the transmitted information about the destination address including information contained in the frame information of the received lower layer frame, and information about a destination address of an upper layer corresponding to the destination address from the frame information; and

among said plurality of packet transfer apparatuses, one packet transfer apparatus, having the transmission source address, receives said lower layer destination address and said upper layer destination address, and rewrites said first table based on the received lower layer destination address and the received upper layer destination address.

4. – 6. (Cancelled)

7. (Currently Amended) A packet communication method according to claim 1, further comprising

in a connectionless packet transfer network which is logically built on a connection network,

a notification procedure executed by a connectionless packet communication terminal which records statistical information containing a band and priority for each flow defined by a transmission source address and destination address for a packet transmitted/received in the connectionless packet communication terminal and notifies a traffic control apparatus serving as a network control server of the recorded statistical information, and

a flow list creation procedure executed by a said traffic control apparatus which creates a flow list in which information containing the transmission source address, destination address, priority, and band is registered for each flow, on the basis of the statistical information sent from the connectionless packet communication terminal.

8. (Previously Presented) A packet communication method according to claim 7, further comprising

a flow list sorting procedure which sorts the flow list in descending order of priority and sorts flows with the same priority in descending order of band, and

a connection candidate list creation procedure which, assuming that a connection is set between a transmission source connectionless packet communication terminal and a destination connectionless packet communication terminal of each flow registered in the sorted flow list, creates a connection candidate list by assigning a connection candidate for all flows sequentially from an uppermost flow in the flow list.

9. (Previously Presented) A packet communication method according to claim 7, wherein a connection candidate list creation procedure creates a connection candidate list by assigning not less than one flow having the same transmission source connectionless packet communication terminal, the same destination connectionless packet communication terminal, and the same priority to the same connection candidate without making a sum of bands exceed a capacity of the connection candidate and determining the priority and band of the connection candidate on the basis of the priority and the sum of the bands of assigned flows.

10. (Previously Presented) A packet communication method according to claim 8, further comprising

a connection candidate list sorting procedure which sorts the connection candidate list in descending order of priority and sorts connection candidates with the same priority in descending order of band, and

a reservation procedure which reserves a connection interface of the connectionless packet communication terminal for all connection candidates contained in the sorted connection candidate list sequentially from an uppermost connection candidate in the sorted connection candidate list.

11. (Previously Presented) A packet communication method according to claim 10, further comprising

a selection procedure which selects, on the basis of the connection candidate list sorted by the connection candidate list sorting procedure, a connection requiring no setting from a connection solution list in which connections to be set are registered,

a comparison procedure which sets, as a connection candidate as a processing target, a connection candidate for which reservation is possible in the sorted connection candidate list and compares the priority and band of the connection candidate as the processing target with those of the selected connection,

a connection solution list creation/update procedure which, when the priority and band of the connection candidate as the processing target are more than those of the selected connection, excludes the connection candidate as the processing target from the connection candidate list and adds the connection candidate as the processing target to the connection solution list, and excludes the selected connection from the connection solution list and adds the selected connection to the connection candidate list, and a taboo connection list registration procedure which, when the priority and band of the connection candidate as the processing target are not more than those of the selected connection, registers the connection candidate as the processing target in a taboo connection list,

wherein the comparison procedure sets, of the connection candidates for which reservation is possible, an uppermost connection candidate which is not registered in the taboo connection list as the connection candidate as the processing target.

12. (Previously Presented) A packet communication method according to claim 10, further comprising

a selection procedure which selects, on the basis of the connection candidate list sorted by the connection candidate list sorting procedure, a connection requiring no setting from a connection solution list in which connections to be set are registered,

a comparison procedure which sets, as a connection candidate as a processing target, a connection candidate for which reservation is possible in the sorted connection candidate list and compares the priority and band of the connection candidate as the processing target with those of the selected connection,

a connection solution list creation/update procedure which, when the priority and band of the connection candidate as the processing target are more than those of the selected connection, excludes the connection candidate as the processing target from the connection candidate list and adds the connection candidate as the processing target to the connection solution list, and excludes the selected connection from the connection solution list and adds the selected connection to the connection candidate list,

a taboo connection list registration procedure which records the connection candidate as the processing target in a taboo connection list together with the current number of times of execution of the comparison procedure, and

a taboo connection list delete procedure which deletes, from the taboo connection list, a connection candidate recorded together with the number of times of execution which is smaller than the current number of times of execution of the comparison procedure by not less than a predetermined number,

wherein the comparison procedure sets, of the connection candidates for which reservation is possible, an uppermost connection candidate which is not registered in the taboo connection list as the connection candidate as the processing target.

13. (Previously Presented) A packet communication method according to claim 11, further comprising

a route calculation procedure which calculates a route when the uppermost connection in the connection solution list between the transmission source connectionless packet communication terminal and the destination connectionless packet communication terminal,

a connection setting procedure which, when a transmission resource necessary for transmitting the uppermost connection can be ensured in a transmission link on the calculated route, controls the switching function of the connection switch node to set the uppermost connection, controls the transmission function of the transmission source connectionless packet communication terminal of the flow to transmit the flow assigned to the uppermost connection by using the connection, and excludes the uppermost connection from the connection solution list, and

a connection solution list delete procedure which, when the transmission resource cannot be ensured, excludes the uppermost connection from the connection solution list and adds the uppermost connection to the connection candidate list.

14. (Previously Presented) A packet communication method according to claim 12, further comprising

a route calculation procedure which calculates a route when the uppermost connection in the connection solution list between the transmission source connectionless packet communication terminal and the destination connectionless packet communication terminal,

a connection setting procedure which, when a transmission resource necessary for transmitting the uppermost connection can be ensured in a transmission link on the calculated route, controls the switching function of the connection switch node to set the uppermost connection, controls the transmission function of the transmission source connectionless packet communication terminal of the flow to transmit the flow assigned to the uppermost connection by using the connection, and excludes the uppermost connection from the connection solution list, and

a connection solution list delete procedure which, when the transmission resource cannot be ensured, excludes the uppermost connection from the connection solution list and adds the uppermost connection to the connection candidate list.

15. (Previously Presented) A packet communication method according to claim 13, wherein when the connection solution list is empty, when the connection interface cannot be reserved for any of the connection candidates registered in the connection candidate list, or when the

transmission resource cannot be ensured for any of the connections registered in the connection solution list, one of a series of procedures including:

the flow list sorting procedure, the connection candidate list creation procedure, the connection candidate list sorting procedure, the reservation procedure, the selection procedure, the comparison procedure, the connection solution list creation/update procedure, the taboo connection list registration procedure, the route calculation procedure, the connection setting procedure, and the connection solution list delete procedure, and

a series of procedures including:

the flow list sorting procedure, the connection candidate list creation procedure, the connection candidate list sorting procedure, the reservation procedure, the selection procedure, the comparison procedure, the connection solution list creation/update procedure, the taboo connection list registration procedure, the taboo connection list delete procedure, the route calculation procedure, the connection setting procedure, and the connection solution list delete procedure is ended.

16. (Previously Presented) A packet communication method according to claim 14, wherein when the connection solution list is empty, when the connection interface cannot be reserved for any of the connection candidates registered in the connection candidate list, or when the transmission resource cannot be ensured for any of the connections registered in the connection solution list, one of a series of procedures including:

the flow list sorting procedure, the connection candidate list creation procedure, the connection candidate list sorting procedure, the reservation procedure, the selection procedure, the comparison procedure, the connection solution list creation/update procedure, the taboo connection list registration procedure, the route calculation procedure, the connection setting procedure, and the connection solution list delete procedure, and

a series of procedures including the flow list sorting procedure, the connection candidate list creation procedure, the connection candidate list sorting procedure, the reservation procedure, the selection procedure, the comparison procedure, the connection solution list creation/update procedure, the taboo connection list registration procedure, the taboo connection list delete procedure, the route calculation procedure, the connection setting procedure, and the connection solution list delete procedure is ended.

17. (Previously Presented) A packet communication method according to claim 7, further comprising a notification interval setting procedure which causes the traffic control apparatus to set a notification interval of the statistical information for the connectionless packet communication terminal,

wherein the notification procedure records the statistical information, sent from the connectionless packet communication terminal, at the set notification interval and notifies the traffic control apparatus of the statistical information, and

the flow list creation procedure updates the flow list on the basis of the statistical information sent from the connectionless packet communication terminal.

18. (Previously Presented) A packet communication method according to claim 7, further comprising a threshold value setting procedure which causes the traffic control apparatus to set a threshold value of the band for each flow for the connectionless packet communication terminal,

wherein the notification procedure records the statistical information for each flow for the received packet, and when the band of the recorded flow exceeds the set threshold value, notifies the traffic control apparatus of the statistical information of the flow whose band exceeds the threshold value, and

the flow list creation procedure updates the flow list on the basis of the statistical information sent from the connectionless packet communication terminal.

19. (Previously Presented) A packet communication method according to claim 1, further comprising

in a connectionless packet transfer network which is logically build on a connection network comprising a transmission link having a connection multiplex transmission function and a connection switch node having a connection switching function by adding, as a terminal function unit, a connectionless packet transfer node serving as the frame transfer apparatus and a connectionless packet communication terminal serving as the packet transfer apparatus to the connection network, when communication is to be executed between the connectionless packet communication terminals,

a transfer node selection procedure which selects, as a connection setting target, a connectionless packet transfer node for which the number of connection switch nodes arranged between the connectionless packet transfer node and a destination connectionless packet communication terminal to receive a packet is minimum,

a first connection setting procedure which causes a control apparatus serving as the network control server to control the connection switch node to set a first connection between a transmission source connectionless packet communication terminal to transmit the packet and the connectionless packet transfer node as the setting target, and

a second connection setting procedure which causes the control apparatus to control the connection switch node to set a second connection between the connectionless packet transfer node as the setting target and the destination connectionless packet communication terminal.

20. (Previously Presented) A packet communication method according to claim 19, further comprising

a transmission setting procedure which causes the control apparatus to control the transmission source connectionless packet communication terminal to transmit the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal by using the first connection, and

a transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the setting target to transfer, to the second connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal.

21. (Previously Presented) A packet communication method according to claim 1, further comprising

in a connectionless packet transfer network which is logically built on a connection network comprising a transmission link having a connection multiplex transmission function and a connection switch node having a connection switching function by adding, as a terminal function unit, a connectionless packet transfer node serving as the frame transfer apparatus and a connectionless packet communication terminal serving as the packet transfer apparatus to the

connection network, when communication is to be executed between the connectionless packet communication terminals,

- a first transfer node selection procedure which selects, as a first connection setting target, a connectionless packet transfer node for which the number of connection switch nodes arranged between the connectionless packet transfer node and a transmission source connectionless packet communication terminal to transmit a packet is minimum,

- a second transfer node selection procedure which selects, as a second connection setting target, a connectionless packet transfer node for which the number of connection switch nodes arranged between the connectionless packet transfer node and a destination connectionless packet communication terminal to receive the packet is minimum,

- a first connection setting procedure which causes a control apparatus serving as the network control server to control the connection switch node to set a first connection between the connectionless packet transfer node as the first connection setting target and the connectionless packet transfer node as the second connection setting target,

- a second connection setting procedure which causes the control apparatus to control the connection switch node to set a second connection between the transmission source connectionless packet communication terminal and the connectionless packet transfer node as the first connection setting target, and

- a third connection setting procedure which causes the control apparatus to control the connection switch node to set a third connection between the connectionless packet transfer node as the second connection setting target and the destination connectionless packet communication terminal.

22. (Previously Presented) A packet communication method according to claim 21, further comprising

- a transmission setting procedure which causes the control apparatus to control the transmission source connectionless packet communication terminal to transmit the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal by using the second connection,

- a first transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the first transfer setting target to transfer, to the first

connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal, and

a second transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the second transfer setting target to transfer, to the third connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal.

23. (Previously Presented) A packet communication method according to claim 1, further comprising

in a connectionless packet transfer network which is logically built on a connection network comprising a transmission link having a connection multiplex transmission function and a connection switch node having a connection switching function by adding, as a terminal function unit, a connectionless packet transfer node serving as the frame transfer apparatus and at least one connectionless packet communication terminal serving as the packet transfer apparatus to the connection network, when communication is to be executed between connectionless packet communication terminals,

a first transfer node selection procedure which selects, as a first connection setting target, a connectionless packet transfer node in a first area to which a transmission source connectionless packet communication terminal to transmit a packet belongs,

a second transfer node selection procedure which selects, as a second connection setting target, a connectionless packet transfer node in a second area to which a destination connectionless packet communication terminal to receive the packet belongs,

a third transfer node selection procedure which selects, as a third connection setting target, a connectionless packet transfer node for which the number of connection switch nodes arranged between the connectionless packet transfer node and the transmission source connectionless packet communication terminal is minimum,

a fourth transfer node selection procedure which selects, as a fourth connection setting target, a connectionless packet transfer node for which the number of connection switch nodes arranged between the connectionless packet transfer node and the destination connectionless packet communication terminal is minimum,

a first connection setting procedure which causes a control apparatus serving as the network control server to control the connection switch node to set a first connection between the connectionless packet transfer node as the first connection setting target and the connectionless packet transfer node as the second connection setting target,

a second connection setting procedure which causes the control apparatus to control the connection switch node to set a second connection between the transmission source connectionless packet communication terminal and the connectionless packet transfer node as the third connection setting target,

a third connection setting procedure which causes the control apparatus to control the connection switch node to set a third connection between the connectionless packet transfer node as the third connection setting target and the connectionless packet transfer node as the first connection setting target,

a fourth connection setting procedure which causes the control apparatus to control the connection switch node to set a fourth connection between the connectionless packet transfer node as the fourth connection setting target and the destination connectionless packet communication terminal, and

a fifth connection setting procedure which causes the control apparatus to control the connection switch node to set a fifth connection between the connectionless packet transfer node as the second connection setting target and the connectionless packet transfer node as the fourth connection setting target.

24. (Previously Presented) A packet communication method according to claim 23, further comprising

a transmission setting procedure which causes the control apparatus to control the transmission source connectionless packet communication terminal to transmit the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal by using the second connection,

a first transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the third transfer setting target to transfer, to the third connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal,

a second transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the first transfer setting target to transfer, to the first connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal,

a third transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the second transfer setting target to transfer, to the fifth connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal, and

a fourth transfer setting procedure which causes the control apparatus to control the connectionless packet transfer node as the fourth transfer setting target to transfer, to the fourth connection, the packet from the transmission source connectionless packet communication terminal to the destination connectionless packet communication terminal.

25. (Previously Presented) A packet communication method according to claim 23, wherein the connectionless packet transfer node as the third connection setting target and the connectionless packet transfer node as the first connection setting target, which are present in the first area, are connected through a plurality of connectionless packet transfer nodes and connections present in the first area, and the connectionless packet transfer node as the fourth connection setting target and the connectionless packet transfer node as the second connection setting target, which are present in the second area, are connected through a plurality of connectionless packet transfer nodes and connections present in the second area.

26. (Previously Presented) A packet communication method according to claim 19, further comprising

a notification procedure which records, as statistical information, a band of each flow defined by a pair of the transmission source address and destination address for the packet transmitted/received in the connectionless packet transfer node and notifies the control apparatus of the recorded statistical information, and

a flow list creation procedure which causes the control apparatus to create a flow list in which information containing the transmission source address, destination address, and band is

registered for each flow, on the basis of the statistical information sent from the connectionless packet transfer node,

wherein when a connectionless packet transfer node for which a sum of bands of pass flows exceeds a predetermined threshold value is detected by the flow list in setting the connection, a connection which does not pass through the connectionless packet transfer node is set.

27. (Previously Presented) A packet communication method according to claim 21, further comprising

a notification procedure which records, as statistical information, a band of each flow defined by a pair of the transmission source address and destination address for the packet transmitted/received in the connectionless packet transfer node and notifies the control apparatus of the recorded statistical information, and

a flow list creation procedure which causes the control apparatus to create a flow list in which information containing the transmission source address, destination address, and band is registered for each flow, on the basis of the statistical information sent from the connectionless packet transfer node,

wherein when a connectionless packet transfer node for which a sum of bands of pass flows exceeds a predetermined threshold value is detected by the flow list in setting the connection, a connection which does not pass through the connectionless packet transfer node is set.

28. (Previously Presented) A packet communication method according to claim 23, further comprising

a notification procedure which records, as statistical information, a band of each flow defined by a pair of the transmission source address and destination address for the packet transmitted/received in the connectionless packet transfer node and notifies the control apparatus of the recorded statistical information, and

a flow list creation procedure which causes the control apparatus to create a flow list in which information containing the transmission source address, destination address, and band is

registered for each flow, on the basis of the statistical information sent from the connectionless packet transfer node,

wherein when a connectionless packet transfer node for which a sum of bands of pass flows exceeds a predetermined threshold value is detected by the flow list in setting the connection, a connection which does not pass through the connectionless packet transfer node is set.